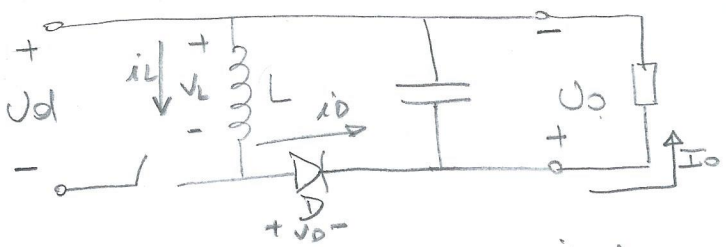
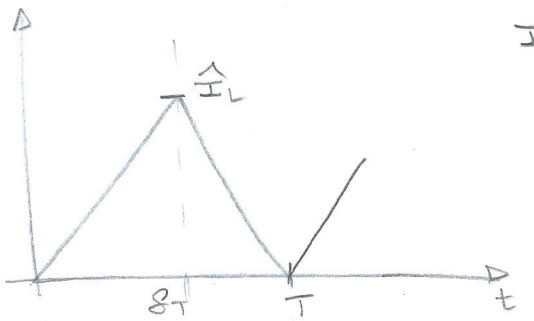
Solución Problema 2

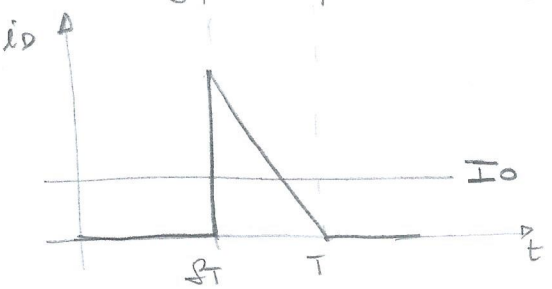


$V_d = 24V \quad V_o = 42V \quad P_o = 60W$

$f = 100kHz \quad \Delta V_o = 0,01 \cdot 42\ V.$

a) Funcionamiento en el LCC: i_L





$$I_o = \frac{P_o}{V_o} = \frac{60}{42} = 1,43A.$$

$$\Rightarrow \text{Vale que} \quad \frac{V_o}{V_d} = \frac{\delta}{1-\delta}$$

$$(1-\delta)V_o = \delta V_d$$

$$\Rightarrow \delta = \frac{V_o}{V_o + V_d} = \frac{42}{42+24}$$

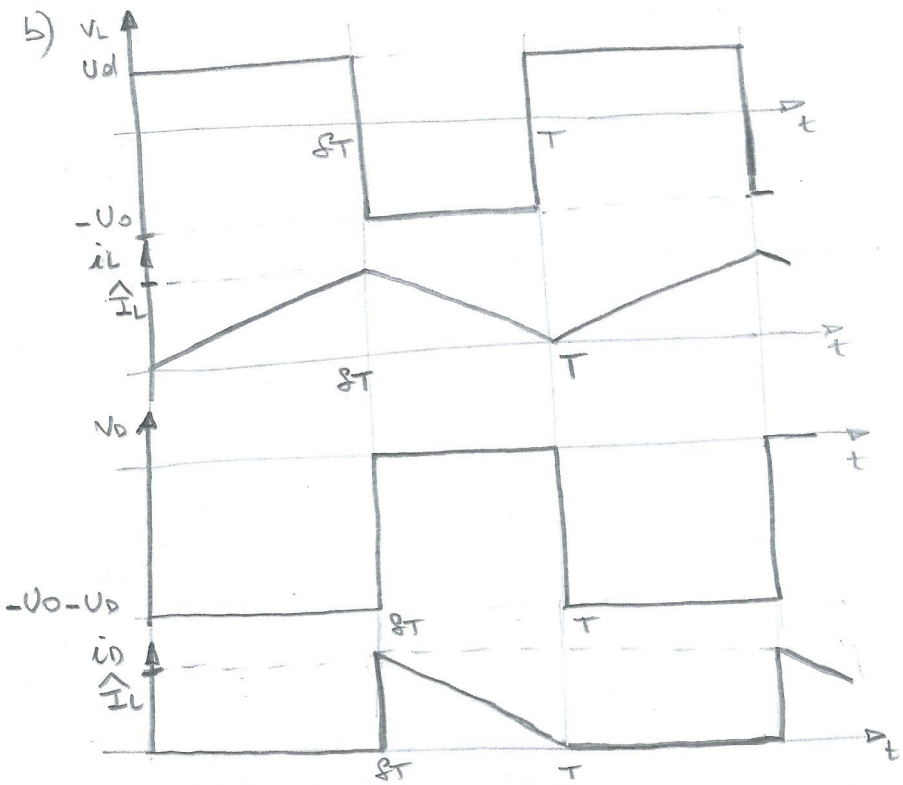
$$\Rightarrow \boxed{\delta = 0,636}$$

$$P_{in} = P_{out}$$

$$\left.\begin{aligned} P_{in} &= \frac{1}{2} \cdot L \cdot \hat{I}_L^2 \cdot f \\ \hat{I}_L &= \frac{V_d}{L} \delta T \end{aligned}\right\} \Rightarrow P_{in} = \frac{1}{2} \not{L} \frac{V_d^2 \delta^2 \not{T}^2}{L \not{T}} \not{f} = P_o$$

$$\Rightarrow L = \frac{V_d^2 \cdot \delta^2}{2 P_o f} = \frac{24^2 \cdot 0,636^2}{2 \cdot 60 \cdot 100 \times 10^3} \Rightarrow \boxed{L = 19,42\mu H}$$

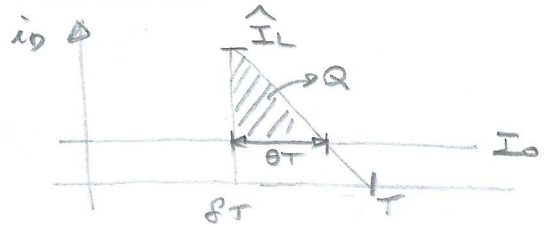
b)



$$\hat{I}_L = \frac{V_d \delta}{L f} = \frac{24 \cdot 0,636}{19,42 \times 10^{-6} \cdot 100 \times 10^3}$$

$$\hat{I}_L = 7,86A.$$

Solución Problema 2 (cont)



c) $\Delta U_o = 0{,}01 \cdot 42 = 0{,}42\,V$

$\Delta U_o = \frac{Q}{C} \Rightarrow C = \frac{Q}{\Delta U_o}$

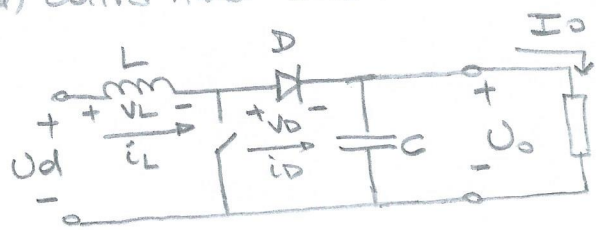
$Q = \frac{1}{2} \cdot \theta T (\hat{I}_L - I_o)$

$\frac{\theta T}{(1-\delta)T} = \frac{\hat{I}_L - I_o}{\hat{I}_L} \Rightarrow \theta T = \frac{\hat{I}_L - I_o}{\hat{I}_L}(1-\delta)T \Rightarrow Q = \frac{1}{2}\frac{(\hat{I}_L - I_o)^2 (1-\delta)T}{\hat{I}_L}$

$\Rightarrow C = \frac{1}{2}\frac{(\hat{I}_L - I_o)^2 (1-\delta)T}{\Delta U_o \cdot \hat{I}_L} = \frac{1}{2}\frac{(7{,}86 - 1{,}43)^2 (1 - 0{,}636)}{0{,}42 \cdot 7{,}86 \cdot 100 \times 10^3}$

$\Rightarrow \boxed{C = 22{,}79\,\mu F}$

d) Convertidor Boost:



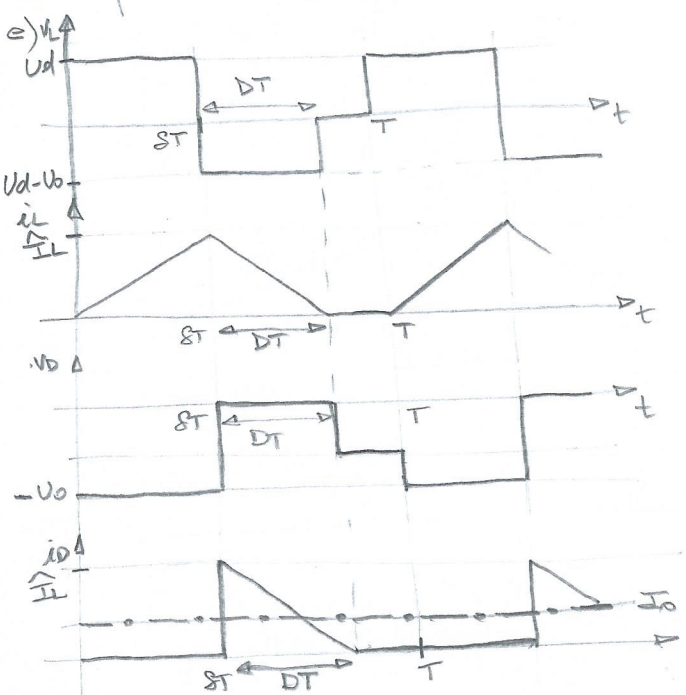
e) Asumo que el convertidor opera en MCC:

$\Rightarrow \frac{U_o}{U_d} = \frac{1}{1-\delta} \rightarrow 1 - \delta = \frac{U_d}{U_o} \Rightarrow \delta = 1 - \frac{U_d}{U_o} = 1 - \frac{24}{42} = 0{,}43$

$\Delta I_L = \frac{U_d}{L} \cdot \delta T = \frac{24 \cdot 0{,}43}{19{,}42 \times 10^{-6} \cdot 100 \times 10^3} = 5{,}31\,A$

$\langle I_L \rangle \cdot U_d = P_{in} = P_o \Rightarrow \langle I_L \rangle = \frac{P_o}{U_d} = \frac{60}{24} = 2{,}5\,A$ pero $\frac{\Delta I_L}{2} = 2{,}66 > \langle I_L \rangle \Rightarrow$ el convertidor está operando en MCD

e)



$I_o = \frac{1}{T}\frac{1}{2} \cdot DT\,\hat{I}_L$

$\hat{I}_L = \frac{U_d}{L} \cdot \delta T$

$U_d \cdot \delta T = (U_o - U_d) DT \Rightarrow DT = \frac{U_d \delta T}{U_o - U_d}$

$\Rightarrow I_o = \frac{1}{T}\frac{1}{2} \cdot \frac{U_d \delta T}{U_o - U_d} \cdot \frac{U_d}{L} \cdot \delta T$

$I_o = \frac{U_d^2 \cdot \delta^2}{2(U_o - U_d) \cdot L \cdot f}$

$\delta = \sqrt{\frac{2 I_o (U_o - U_d) \cdot L \cdot f}{U_d^2}}$

$\delta = \sqrt{\frac{2 \cdot 1{,}43 (42 - 24) \cdot 19{,}42 \times 10^{-6} \cdot 100 \times 10^3}{24^2}}$

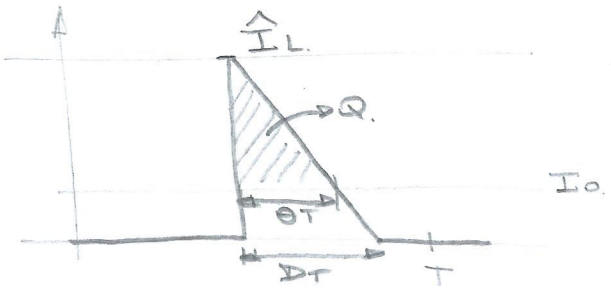
$\boxed{\delta = 0{,}417}$

Solución Problema 2 (cont. 1)

$$\hat{I}_L = \frac{Ud}{L}\delta T = \frac{24 \cdot 0,417}{19,42\times10^{-6} \cdot 100\times10^{3}} = 5,15\,A$$

$$DT = \frac{24 \cdot 0,417}{(42-24)\cdot 100\times10^{3}} = 5,56\,\mu s$$

f) $C = 45,59\,\mu F$



$$\Delta U_o = \frac{Q}{C}$$

$$Q = \frac{1}{2}\delta T \cdot (\hat{I}_L - I_o)$$

$$\Rightarrow Q = \frac{1}{2}\frac{(\hat{I}_L - I_o)^2 DT}{\hat{I}_L} \Rightarrow \Delta U_o = \frac{(\hat{I}_L - I_o)^2 \cdot DT}{2 \cdot \hat{I}_L \cdot C}$$

$$\Rightarrow \Delta U_o = \frac{(5,15-1,43)^2 \cdot 5,56\times10^{-6}}{2 \cdot 5,15 \cdot 22,79\times10^{-6}} \Rightarrow \Delta U_o = 0,32\,V$$

$\Downarrow$

el rizado es $0,78\% < 1\%$ ✓